

A TELECOMMUNICATION NETWORK AND A METHOD FOR  
CONTROLLING SUCH NETWORK  
*BACKGROUND OF the Invention*

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5 The invention relates to a telecommunication network, a method of  
controlling such network and to a component of such network.

In order to establish communications between subscribers, a  
telecommunication network comprises several kinds of multiplexers in series.  
Generally, the first multiplexer which is connected to the network is called a  
switching node (SN) and the multiplexer which is the closest to a subscriber is  
10 called an access node (AN). An access node may be also connected to a  
switching node through another multiplexer which will be called here a  
subswitching node or subscriber-switching node.

The switching node and subswitching node are generally controlled  
by the network operator. The access nodes are located in subscribers'  
15 installations; they are generally owned or leased by subscribers. As access  
nodes and subswitching nodes are sold or leased in great numbers, it is  
preferable that their cost be limited, i.e. that they be realized with the greatest  
simplicity; in order to achieve this goal, the most complex control means are  
installed in the switching node.

20 For this purpose, *the VB5.1 ETSI standard* recommends the  
following network structure: each user or subscriber is connected through an  
access node or a subswitching node to a switching node via virtual paths (VP).  
A virtual path comprises generally several virtual channels (VC). A given  
bandwidth (i.e. a given bit rate) is allocated to each virtual path; this bandwidth  
25 may have different values in the upward and the downward directions. The  
upward direction is from the user to the network and the downward direction is  
from the network to the user; the downward direction needs generally more  
bandwidth than the upward direction. In fact, in the upward direction, simple  
requests are sent and in the downward direction important files are generally  
30 sent.

For instance, 8 Mbits/sec. is allocated to the downward direction (from the switching node to the subscriber node) and 800 Kbits/sec. is allocated to the upward direction (from the access node to the switching node).

If, with this VB5.1 standard, the total bandwidth is (downward) 8 Mbits/sec. between the switching node and the subscriber node and if there are 8 VP, each one has a bandwidth of 1 Mbit/sec., if the resources are distributed equally.

Therefore, the subscriber node (access and/or subswitching node) is very simple because it does not comprise any control means for controlling the connection and the bandwidth. However, this simplicity has the drawback that it is not possible to allocate temporarily more bandwidth to a VP, i.e. to a user.

When a user has the possibility to transmit and receive data with different qualities of service (QOS), i.e. with different priorities, one or several virtual channels VC is allocated to each quality of service. In that case, the corresponding virtual path must be provided with control means, generally called "shaping control means", which take into account the bandwidth of each virtual channel in order to limit the total bandwidth of the virtual path to the bandwidth which is allocated to this virtual path. The shaping control means are expensive. Therefore, the goal of simplicity and low cost for the users' equipment is no more achieved.

In order to allocate dynamically the bandwidth to each VC, it is possible to use *another ETSI standard named VB5.2*. But the drawback of this technology is that the access node or subswitching node is complex and, therefore, more expensive. In fact, in this standard, the access or subswitching node controls dynamically the up and down connections and may provide instantaneously the requested bandwidth to each VC under the control of call control means provided in the switching node. It can be easily understood that the high cost stems from the fact that, for such call processing in the access node or subswitching node, it is necessary to use important memory means and processing power.

In the network according to the invention, the access node or subswitching node is almost as simple as in the VB5.1 standard but provides the possibility to allocate dynamically the bandwidth to each VP.

5 The invention takes advantage of the asymmetrical character of the traffic.

The network according to the invention is characterized in that, in the downward direction, the bandwidth allocated to each virtual path is variable under the control of means provided upwards, i.e. for instance, in the switching node, and in that, in the upward direction, each VP has a fixed bandwidth.

10 Therefore, it is not necessary to provide the users' equipment (access node or subswitching node) with means controlling the bandwidth. In other words, the users' equipment may be as simple as with the VB5.1 standard, but the invention provides the possibility to modify dynamically the bandwidth of each virtual path.

15 The equipment for controlling the downward bandwidth is preferably under the control of the network operator and is installed, as mentioned above, for instance, in the switching node. This control equipment is provided with information about the maximum bandwidth of each user, i.e. generally of each virtual path, and about the maximum bandwidth at the interface between the switching node and the access or subscriber node. In fact, the bandwidth of  
20 each user is an information which is given at the time of subscription and the bandwidth at the interface between the switching node and all the users' node is a characteristic feature of the switching node.

25 Therefore, for each downward connection, between the switching node and the users, the control equipment allocates the necessary bandwidth to each user, i.e. to each virtual path, taking into account the maximum bandwidth which may be allocated to each user and the maximum bandwidth of the interface.

30 It may be also possible to control upstream the bandwidth allocated downstream to each virtual channel. This control may be performed in the following way:

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to the users, is greater than the upward data rate, from the users to the network. Multiplexers are provided for establishing connections, constituting virtual channels, between users and the network; the virtual channels are grouped into virtual paths. In each multiplexer close to the user, the bandwidth  
5 allocated to each downward virtual path is variable under the control of means, such as call control means, provided upstream in a switching node and the upward virtual paths have a fixed bandwidth.

According to an embodiment, the control means is provided with a memory containing information representing the maximum bandwidth allocated  
10 downwardly to each user and representing the bandwidth allocated downwardly to the interface, or the interfaces, between the users' multiplexer and the switching node, this control means using these information in order to limit the bandwidth allocated to each user to its authorized maximum, and in order to limit the total bandwidth allocated to the virtual paths to a value which is at most  
15 equal to the interface, or to interfaces, bandwidth.

A control of the upward bandwidth is also needed to check whether the bandwidth allocated upstream for VC's still fits within the fixed bandwidth associated with the upstream VP.

In an embodiment, in the downward direction, each virtual channel is  
20 assigned a permanent or semi permanent quality of service.

In an embodiment, the multiplexer which is the closest to the user has, for each virtual channel of the downward direction, a buffer memory for ATM cells with a given priority.

The invention relates also to a multiplexer constituting a node of a  
25 telecommunication network for transmitting ATM cells, this node being close to a user. In this multiplexer, each downward virtual path has a plurality of virtual channels to each of which is allocated a given quality of service.

In an embodiment, to each virtual channel is assigned a buffer  
memory for the ATM cells to which is assigned a priority corresponding to the  
30 given quality of service.

The invention relates also to a method for controlling a telecommunication network, in which connections are realized by virtual channels grouped into virtual paths. The bandwidth of the downward virtual paths are controllable dynamically from an upstream controller and the bandwidth of each upward virtual path is fixed.

10 given quality of service.

15 The example *Detailed description of the invention* which will be described corr

In the example represented on the drawing, the ATM network 10 is connected to a switching node 12 through virtual paths 14 and 16, each virtual path comprising several virtual channels. For the sake of simplicity, only two virtual channels have been represented for each virtual path. These virtual

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The switching node 12 connects these virtual paths 14, 16 to a plurality of users also through virtual paths.

The access nodes 22 and 25, the subswitching node 28 and the switching node 12 are multiplexers, the goal of which is to establish communications between users and the network 10 and/or between users connected to the same node.

The connections between the user 24 and the switching node 12 are obtained through a downward virtual path 32 and through an upward virtual path 34. Similarly, the connections between the user 26 and the switching node 12 are realized through a downward virtual path 36 and through an upward virtual path 38. The connections between the user 20 and the switching node 12 are realized through a downward virtual path 40 and an upward virtual path 42.

30           The upward virtual paths 34, 38, 42 and 43 have a fixed bandwidth,  
i.e. a given maximum bit rate, but the downward virtual paths 32, 36, 40 and 41  
have a variable bandwidth controlled by means 30.

For the control of the bandwidth of the downward connections, the means 30 is provided with a memory (not shown) containing an information representing the maximum downward bandwidth allocated to each user and the maximum downward bandwidth allocated to the interface 44 between the switching node 12 and the subswitching node 28.

Knowledge of the maximum upward bandwidth associated with the upstream VP is also required to enforce the upstream allocated to VCs remains within the VP limits.

The call control means 30 has, in addition to its classical function of establishing the connections, the role of allocating the bandwidth for the downward connections, i.e. from the network 10 to the users.

Upstream bandwidth allocation is also performed within the VP bandwidth (standard VB5.2 behavior).

The connections which are established are connections through virtual channels. In the simplified example represented on the drawing, each virtual path has two virtual channels. For instance, the virtual path 32 has two virtual channels 32<sub>1</sub> and 32<sub>2</sub> respectively.

When a new downward connection is established, the call control means 30 checks that the bandwidth which is allocated to all the users is at most equal to the bandwidth allocated to the interface 44 and this call control function 30 checks also that the bandwidth which is globally allocated to each user is at most equal to the maximum bandwidth authorized for this user.

According to another aspect of the invention, each virtual channel between the switching node 12 and the users is allocated a quality of service (QOS). For the sake of simplicity, it will be assumed here that only two qualities of services are available: CBR and UBR. For instance, the virtual channel 32<sub>1</sub> corresponds to CBR and the virtual channel 32<sub>2</sub> corresponds to UBR.

For this purpose, to each virtual channel is associated, in each node, a buffer memory in which the cells have a given a priority with respect to the cells in the buffer memory associated with the other virtual channel. For instance, the buffer memory 46 is, in the subswitching node 28, associated with virtual channel 32<sub>1</sub> (CBR), and a buffer memory 48 is associated with the



virtual channel 32<sub>2</sub> corresponding to the UBR quality of service. The cells in buffer memory 46 have, in general, a higher priority than the cells in buffer memory 48.

5       The association of each virtual channel with a given quality of service may be realized permanently, i.e. it may not be modified, or may be realized semi permanently, i.e. it may be modified from time to time. For instance, the subswitching node 28 may be such that the number of virtual channels having a given quality of service may be modified under given circumstances, such as a change of subscription contract.

10       In the upward direction, the bandwidth is much more limited than in the downward direction, for instance ten times less and to each user is allocated a fixed bandwidth which may not be varied. In this upward direction, the network is similar to the network of the VB5.1 standard. It is recalled here that, for checking that each user does not transmit more bandwidth than it is  
15       authorized, a police function (not shown) is provided on the upward virtual path between the user and the closest node 28 for instance. This police function checks also that the sum of the fixed upward bandwidths of the users be at most equal to the upward bandwidth of interface 44.

20       In the upward direction, each virtual path 34, 38, 42, 43 has also different virtual channels. However, contrary to the downward direction, a quality of service is not assigned to each of these virtual channels. But, of course, each user has the possibility to transmit cells having different qualities of services, for instance CBR and UBR. Therefore, as represented, the user, 21 for instance, provides the corresponding CBR and UBR cells to a multiplexer 50  
25       and to a shaping control circuit 52. In an embodiment, no circuit 52 is provided, but the upstream line is configured in such a way that the upstream rate is intrinsically limited to the upstream VP bandwidth.

30       It is to be noted here that no shaping circuit is provided for the downward direction, neither in the switching node 12, nor in the subswitching node 28, nor in the access node 22 or 25. No specific control circuit is provided in the nodes 28, 22 and 25.

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